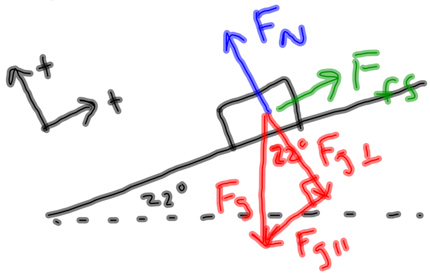
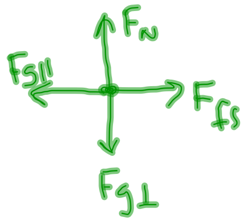
Final Exam Review 1st Block 1.5.12

A 5.5 kg suitcase is at rest on a ramp that is angled 22.0 degrees above the horizontal. What is the coefficient of friction between the suitcase and the surface of the ramp?





$$\mu_s = \frac{F_{fs}}{F_N}$$

$$= \frac{20.2\,N}{49.98\,N}$$

$$= 0.404$$

$$\Sigma F_{\parallel} = 0$$

$$F_{fs} - F_{g\parallel} = 0$$

$$F_{fs} = F_{g\parallel}$$

$$= F_g \sin(22°)$$

$$= m a_g \sin(22°)$$

$$= (5.5\,kg)(9.8\,m/s^2)\sin(22°)$$

$$= 20.2\,N$$

$$\Sigma F_{\perp} = 0$$

$$F_N - F_{g\perp} = 0$$

$$F_N = F_{g\perp}$$

$$= m a_g \cos(22°)$$

$$= (5.5\,kg)(9.8\,m/s^2)\cos(22°)$$

$$= 49.98\,N$$

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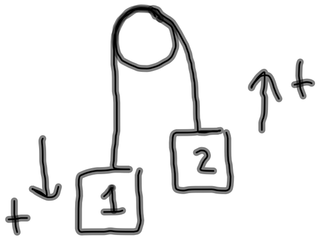
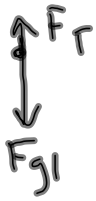
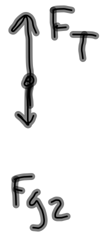
Two masses are hanging by a rope passed over a pulley. The mass on the left is 7.89 kg, and the mass on the right is 6.87 kg. What is the acceleration of the block on the right?



FBD 1:



FBD 2:



* both blocks have same acceleration

$$\Sigma F_1 = m_1 a \qquad \Sigma F_2 = m_2 a$$

$F_{g1} = m_1 a_g$

$F_{g2} = m_2 a_g$

$$F_{g1} - F_T = m_1 a \qquad F_T - F_{g2} = m_2 a$$

$$m_1 a_g - m_2 a_g - m_2 a = m_1 a \qquad F_T = m_2 a_g + m_2 a$$

$$m_1 a + m_2 a = m_1 a_g - m_2 a_g$$

$$a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) a_g$$

$$= \left(\frac{7.89\text{ kg} - 6.87\text{ kg}}{7.89\text{ kg} + 6.87\text{ kg}}\right)(9.8\text{ m/s}^2)$$

$$= 0.677\text{ m/s}^2$$

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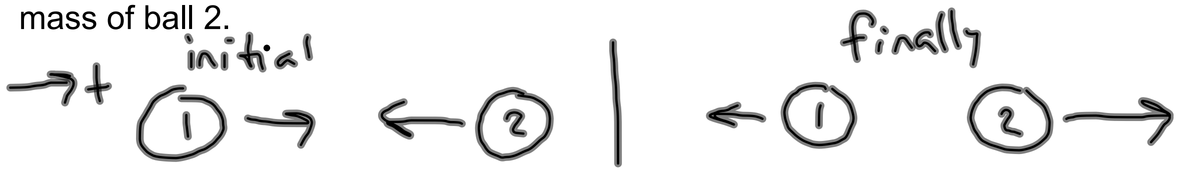
Ball 1 has a mass of 10 kg and is moving initially at 10 m/s to the right. After it collides with ball 2, it has a velocity of 3 m/s to the left. Ball 2 is moving initially at 17 m/s to the left, and after it collides with ball 1 it has a velocity of 22 m/s to the right. Find the mass of ball 2.



$m_1 = 10\ \text{kg}$ $\quad m_2 = ?$

$v_{1i} = +10\ \text{m/s}$ $\quad v_{2i} = -17\ \text{m/s}$

$v_{1f} = -3\ \text{m/s}$ $\quad v_{2f} = +22\ \text{m/s}$

$$m_1 \bar{v}_{1i} + m_2 \bar{v}_{2i} = m_1 \bar{v}_{1f} + m_2 \bar{v}_{2f}$$

$$m_2(\bar{v}_{2i} - \bar{v}_{2f}) = m_1(\bar{v}_{1f} - \bar{v}_{1i})$$

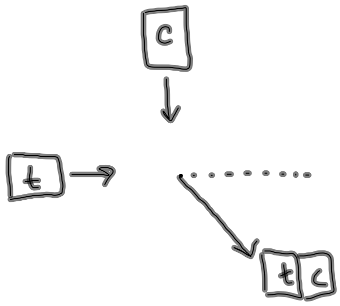
$$m_2 = m_1 \left(\frac{\bar{v}_{1f} - \bar{v}_{1i}}{\bar{v}_{2i} - \bar{v}_{2f}} \right)$$

$$= (10\ \text{kg}) \left[\frac{(-3\ \text{m/s}) - (10\ \text{m/s})}{(-17\ \text{m/s}) - (22\ \text{m/s})} \right]$$

$$= 3.33\ \text{kg}$$

Final Exam Review 1st Block 1.5.12

A 1800 kg car is traveling south with a velocity of 30 m/s and a 2200 kg truck is traveling east with a velocity of 21 m/s. If the car and truck collide and stick together, find the final velocity of the combined mass.



initial

$$\bar{P}_x = \cancel{\bar{P}_{cx}}^{\,0} + \bar{P}_{tx}$$

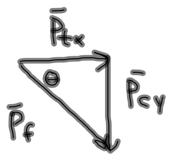
$$\bar{P}_y = \bar{P}_{cy} + \cancel{\bar{P}_{ty}}^{\,0}$$

x-direction: $\bar{P}_{ix} = \bar{P}_{fx}$

$\bar{P}_{tx} = \bar{P}_{fx}$ all comes from truck

y-direction: $\bar{P}_{iy} = \bar{P}_{fy}$

$\bar{P}_{cy} = \bar{P}_{fy}$ all comes from car



$$\bar{P}_{tx} = m_t \bar{v}_{tx}$$
$$= (2200\text{ kg})(21\text{ m/s})$$
$$= 46200\text{ kg·m/s}$$
$$\bar{P}_{cy} = m_c \bar{v}_{cy}$$
$$= (1800\text{ kg})(30\text{ m/s})$$
$$= 54000\text{ kg·m/s}$$

$\bar{P}_f$ → Pyth. theorem for mag.
inverse tangent for angle

$$\bar{P}_f = 71066\text{ kg·m/s @ } 49.5° \text{ S of E}$$

$$\bar{P}_f = m_{total}\bar{v}_f$$

angle and direction of momentum and velocity vectors are ALWAYS the same!

$$v_f = \frac{P_f}{m_{total}} = \frac{71066\text{ kg·m/s}}{(2200\text{ kg} + 1800\text{ kg})} = 17.8\text{ m/s}$$

An average force of 587.5 N is exerted as the Coyote stretches the string back on a giant bow. The string is moved back a distance of 0.744 m as he inserts his body in the box. His mass is 14.57 kg, and it takes him 3.0 s to do this task. He points himself in a horizontal direction, and when the Road Runner passes he takes off from the bow. How fast is he going at his maximum horizontal velocity?